Claims

1. A transparent screen comprising:

a refraction/total reflection plate in a form of a Fresnel lens, the refraction/total reflection plate having a sawtooth light-incidence-side surface upon which light to be projected is incident, and a light-emitting-side surface via which the light to be projected exits; and

an image formation/display plate for forming a projected image from light that exits from said refraction/total reflection plate,

a plurality of refraction slating surface portions each for refracting an incident ray of light to be projected towards said light-emitting-side surface of said refraction/total reflection plate, a plurality of transmission slating surface portions each for making an incident ray of light to be projected pass therethrough, and a plurality of total reflection slating surface portions each for reflecting an incident ray of light passing through one of said plurality of transmission slating surface portions towards said light-emitting-side surface of said refraction/total reflection plate being formed concentrically on the sawtooth light-incidence-side surface of said refraction/total reflection plate, and

said refraction/total reflection plate being formed of a transparent material in which no scattering particles are dispersedly disposed.

2. The transparent screen according to Claim 1, characterized in that said refraction/total reflection plate

is provided with a first transparent substrate that is nearly plate-shaped and a refraction/total reflection structural unit disposed on said first transparent substrate, and said plurality of refraction slating surface portions, said plurality of transmission slating surface portions, and said plurality of total reflection slating surface portions are formed in said refraction/total reflection structural unit.

3. The transparent screen according to Claim 1, characterized in that each of said plurality of refraction slating surface portions refracts an incident ray of light to be projected in a direction of nearly a normal to said transparent screen, and each of said plurality of transmission slating surface portions reflects an incident ray of light to be projected in the direction of nearly the normal to said transparent screen.

4. The transparent screen according to Claim 1, characterized in that a first lenticular lens unit is disposed on the light-emitting-side surface of said refraction/total reflection plate, and said first lenticular lens unit has two or more cylindrical lenses that are extending horizontally and are arranged in upward and downward directions.

5. The transparent screen according to Claim 4, characterized in that said first lenticular lens unit is formed of a material different from that of which said refraction/total reflection plate is formed, and is disposed on the flat light-emitting-side surface of said refraction/total reflection plate.

6. The transparent screen according to Claim 1, characterized in that an array of micro lenses each for diffusing an incident ray of light in many directions is disposed on the light-emitting-side surface of said refraction/total reflection plate.

7. The transparent screen according to Claim 1, characterized in that said image formation/display plate is provided with a second lenticular lens unit for horizontally diffusing the light that exits from said refraction/total reflection plate, and a second transparent substrate for receiving the light diffused by said second lenticular lens unit, and characterized in that said second lenticular lens unit is provided with two or more cylindrical lenses that are extending in upward and downward directions and are arranged in a horizontal direction, and said second transparent substrate includes scattering particles dispersedly arranged therein for forming an image from the light to be projected.

8. The transparent screen according to Claim 1, characterized in that a reflection reduction coating layer for reducing reflection of visible light is formed on the light-incidence-side surface of said refraction/total reflection plate.

9. The transparent screen according to Claim 1, characterized in that a reflection reduction coating layer for reducing reflection of visible light is formed on the light-emitting-side surface of said refraction/total

reflection plate.

10. The transparent screen according to Claim 1, characterized in that a reflection reduction coating layer for reducing reflection of visible light is formed on each of the light-incidence-side and light-emitting-side surfaces of said refraction/total reflection plate.

11. The transparent screen according to Claim 8, characterized in that said reflection reduction coating layer is a single-layer coating formed of a material having a lower index of refraction than that of the transparent material of which said refraction/total reflection plate is formed.

12. The transparent screen according to Claim 8, characterized in that said reflection reduction coating layer is a two-layer coating having a first layer that is coated on said refraction/total reflection plate and is formed of a material having a higher index of refraction than that of the transparent material of which said refraction/total reflection plate is formed, and a second layer that is coated on said first layer and is formed of a material having a lower index of refraction than that of the transparent material of which said refraction/total reflection plate is formed.

13. The transparent screen according to Claim 1, characterized in that said refraction/total reflection plate has a first region in which slating surface portions are formed so that incident rays of light to be projected are made to travel outwardly with respect to a direction of a normal to said the

transparent screen, said first region being located in a vicinity of a common axis which said plurality of refraction slating surface portions, said plurality of transmission slating surface portions, and said plurality of total reflection slating surface portions have in common, and a second region in which slating surface portions are formed so that incident rays of light to be projected are made to travel in a direction of nearly the normal to said the transparent screen, said second region being located farther away from said common axis than said first region.

14. The transparent screen according to Claim 13, characterized in that in said first region, said slating surface portions are formed so that the farther away from said common axis the incident rays of light to be projected are incident upon, the smaller angle the incident rays of light to be projected have with respect to the direction of the normal to said transparent screen.

15. A projection display apparatus characterized in that said projection display apparatus comprises:

a projection optical system for emitting out a beam of light to be projected that enlarges as it travels;

a transparent screen according to Claim 1; and

a plane mirror for reflecting the beam of light to be projected from said projection optical system toward said transparent screen,

and characterized in that said projection optical system is located between said transparent screen and said plane mirror, and below them.